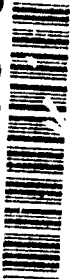




Materials Sciences Corporation

AD-A285 629



**IMPLEMENTATION OF THE MILITARY HANDBOOK 17  
FOR POLYMER MATRIX COMPOSITES AND  
METAL MATRIX COMPOSITES**

September 1 - 30, 1994

DTIC  
ELECTE  
OCT 19 1994  
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Contract No. DAAL01-93-C-4064

Technical Progress Report  
MSC TPR 3458/CA07  
October 1994

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Submitted By:

Crystal H. Newton  
Principal Investigator

Prepared For:

Department of the Army  
U.S. Army Research Laboratory  
Arsenal Street  
Watertown, MA 02172-0001

DTIC QUALITY INSPECTED 6

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October 10, 1994

MSC TPR 3458/CA07

Army Research Laboratory  
AMSRL-MA-S  
405 Arsenal Street  
Watertown, MA 02172-0001

RE: Item No. A001, Contractor's Progress, Status & Management Report,  
Implementation of the Military Handbook 17 for Polymer Matrix Composites  
and Metal Matrix Composites, Contract No. DAAL01-93-C-4064, Technical  
Progress Report, MSC TPR 3458/CA07 - September, 1994

Enclosed are two copies of our Technical Progress Report for the period  
September 1 - 30, 1994. This is in accordance with CDRL A001.

If you have any questions or comments on the contents of this report, please let  
me know.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Crystal H. Newton', is written over a horizontal line.

Crystal H. Newton, Ph.D.  
Project Engineer

CHN/mj

Enclosure (2/0)  
DD250

cc: AMSRL-OP-PR-WT (1/0)  
DTIC-FDA (1/0)

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## 1. MILESTONE PROGRESS

Project effort this month concentrated on support of the Coordination Group meeting and data analysis. Information for the meeting booklet was submitted to ARL. Agendas for two working groups were revised based on progress on data analysis and discussions during the briefing meeting in August. These revisions were sent to the chairmen of the working groups involved. The log of comments submitted for MIL-HDBK-17 was updated and distributed to the working group chairmen.

The executive session, the meeting of the MIL-HDBK-17 working group chairmen, was held on the afternoon of 19 September 1994. The publication schedule for the handbook was revised as follows:

Change Notice 1, Volumes 1 and 3 including all material approved Jan 1993 - Jan 1995	
End of review period New Orleans proceedings	15 Jan 1995
Release	15 Aug 1995
Revision D, Volume 2 including all material approved through July 1995	
End of review period Reno proceedings	July 1995
Release	Feb 1996
Revision E, all three volumes including all material approved through Jan 1996 and any revisions to the outline approved at the 1996 Spring Meeting	
Revision to outline completed, Spring Meeting	Mar 1996
Release	Oct 1996

This schedule is approximate. In particular, the publication of Revision E depends on progress toward revising the outline and completing the revision of Volume 1, Chapter 2 which the working group chairmen feel is important for inclusion in Revision E. During the executive session presentations were made on the publication schedule, handbook progress, agenda items, milestones, data prioritization, and progress on revising the outline for the handbook.

The regression scenario task group met on Monday evening. The results of the discussion were presented during the Guidelines and Statistics working group sessions. Progress of the data pooling task group from the conference calls was also presented.

Data were prepared for submission to and presentation for the Data Review working group. Five sets of data were prepared, representing properties that have not been approved for the handbook to date. These properties include laminate properties for quasi-isotropic tension, open hole tension, strain energy release rate, and bearing, and thermal properties for thermal expansion, thermal conductivity, and specific heat. In each case, lamina mechanical properties have been approved for the handbook for the same materials. These data were presented to the working group. The open hole tension and quasi-isotropic tension data were approved as they were generated using test methods that meet the acceptance criteria and that meet the data documentation requirements.

Most of the activities of the 30th MIL-HDBK meeting are summarized in the draft general session minutes which are attached as Appendix A. These minutes were circulated to the

working group chairmen by email and facsimile with agenda items and information for preparation of the proceedings. Information for inclusion in the proceedings is due at MSC by 4 November 1994. The proceedings will be compiled and printed for distribution by 30 November 1994.

The Intersociety Forum met on Thursday afternoon. The next meeting will be organized by the existing task group with Crystal Newton as chair. Topics for the next meeting are computerization of data and material specifications.

## **2. PROGRESS ADDRESSING IDENTIFIED CONCERNS**

The data pooling task group met via conference call to address one of the barriers for inclusion of data in the handbook. It is anticipated that data pooling methodology, both statistical and engineering, will be ready by the next Coordination Group meeting.

## **3. MANAGEMENT CHANGES**

There were no management changes during this reporting period.

## **4. SCHEDULING CONCERNS**

The schedule for publication of the handbook was revised by the working group chairmen at the executive session. The schedule for preparation of the meeting proceedings was presented to the working group chairmen and distributed by email and facsimile following the meeting. No other scheduling concerns arose during this reporting period.

## **5. COST ELEMENT CONCERNS**

There were no new cost element concerns that arose during this reporting period.

## **6. COST STATUS**

The cost status from the contract start date through this reporting period is shown in Figure 1.

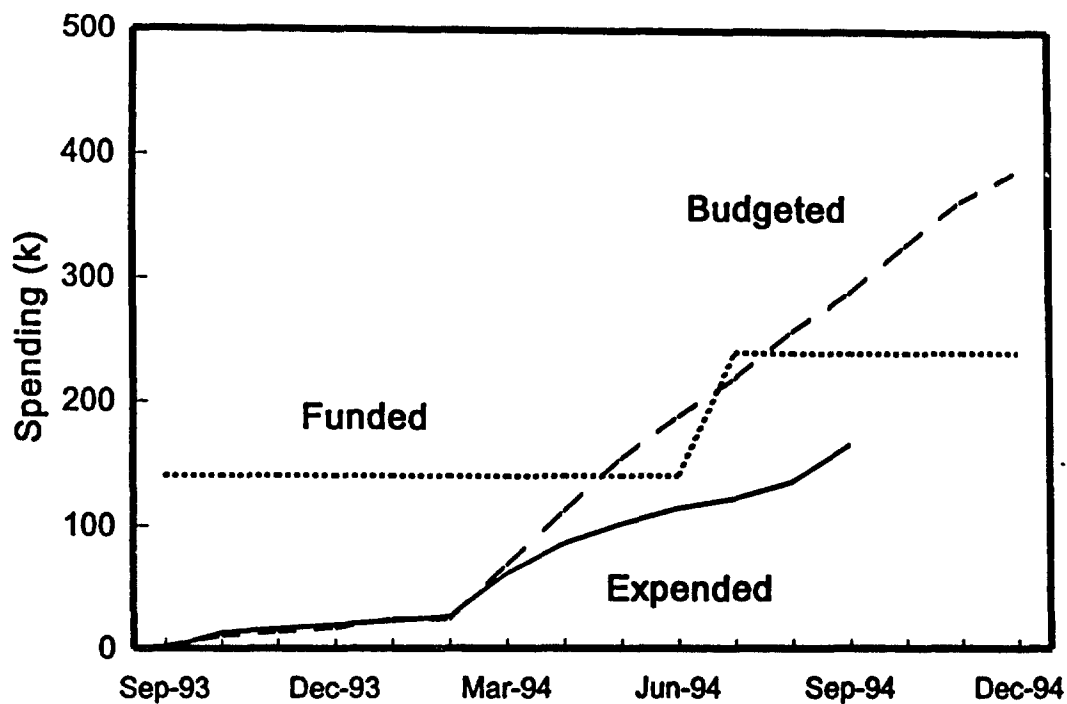


Figure 1. Actual and projected costs for contract to date.

## 7. COST REPORT

The costs incurred during this reporting period and the total contractual expenditures as of 30 September 1994 are shown in the following table:

**TABLE 1. Contract Cost Chart**

	Reporting Period Costs	Cumulative Costs
Labor	\$26,740	\$141,741
Travel	\$3,104	\$9,953
Other Direct Costs	\$0	\$486
Subcontract	\$0	\$0
Other	\$0	\$13,453
<b>Total</b>	<b>\$29,844</b>	<b>\$165,633</b>

## 8. LABOR

The person-hours incurred during this reporting period and the total contractual expenditures as of 30 September 1994 are shown in Table 2:

**TABLE 2. Labor status.**

	Reporting Period	Cumulative
Person-hours	381	1838

## 9. TRAVEL REPORT

Crystal H. Newton, Sailen Chatterjee, and Marty Matulevich traveled to the MIL-HDBK meeting in New Orleans.

## 10. SIGNIFICANT COMMUNICATIONS

### a. Significant Letters

The following letters were received or sent during this reporting period:

MIL-HDBK-17 Project Letters (Sent) Log			
Date	Addressee	File	Topic
9/01/94	Wilcox, Karen		Meeting booklet info
9/12/94	Hart, Bernie		Copy of Volume 1 received 8/1/94

MIL-HDBK-17 Project Letters (Received) Log			
Date	Sender	File	Topic/Notes
9/02/94	Adelmann, John		Testing working group distribution
9/27/94	Bohlmann, Ray		Steam delamination section for handbook

**b. Significant Telephone Contacts**

The following significant telephone contacts occurred during this reporting period:

MIL-HDBK-17 Phone Log:		
Date	Contact(s)	Topic/Notes
8/01/94	Adelmann, John	1-6.6.1.1 is deleted, 6.6.5 title shear tests, no input on MOL criteria, data pooling OK early week of 8/22
9/02/94	Shyprikevich, Peter	Coordination of adhesive joints testing section with 3-2.5.9
9/06/94	Data pooling conference call	Approach for when to use data pooling, if data pooling doesn't work, when can regression analysis be used, Scott and Mark to continue, John to draft flowchart, Crystal to arrange meeting Monday evening for regression scenario
9/ 8/94	Johnson, Steve	Ask to present MMC info at Forum, cannot attend MIL17
9/ 8/94	Reeve, Scott	Location of alternate material section in old and new handbook outlines
9/ 8/94	Reeve, Scott	Data pooling comments and questions
9/ 8/94	Ward, Doug	Regression simulation Mon eve
9/ 9/94	Wilcox, Karen	May not be at next meeting, schedule for preparation for spring meeting
9/ 9/94	Haney, Paul	Next west coast MIL17 meeting
9/12/94	Fields, Rich	Organization of information into Volume 2
9/12/94	Hart, Bernie	Review of publication schedule viewgraphs, Concern re: publication quality of handbook, CHN to send copy

**MIL-HDBK-17 Phone Log:**

<b>Date</b>	<b>Contact(s)</b>	<b>Topic/Notes</b>
9/13/94	Christensen, Steve	Data for more than one batch only at room temperature dry, Cites Peter Shyprykevich's approach for using batch-to-batch variability knock-down for other properties and conditions, looking for other distributions, hasn't looked at analysis files, MIL-17 regression code noted, SC to call Mark Vangel
9/13/94	Kruhmin, Ted	Documentation on CE0036 = 6k! 360-5HS 5W lots, 12k 280-UT 2W lots - CE0037
9/13/94	Mazzola, Joe	Textron interested in updating 5505 B/Ep, adding 5521 B/Ep, and MMC, CHN to send DSIP and meeting info
9/14/94	Campbell, Chris	Will check with Saied on CMC presentation for Forum
9/16/94	Bode, John	Covering thick-section composites working group for Erich Weerth, status of handbook sections, working group chairmen's agenda
9/16/94	Campbell, Chris	Will do CMC at Forum
9/16/94	Soderquist, Joe	Walt Rosen not to attend, Minimum data requirements - Freithsler, Hansen, CHN at meeting, revision of Chapter 2 to be reviewed by Garbo, Shyprykevich, Newton, Soderquist, Field before GWG, publication schedule, JS does not think that Chapter 2 will meet schedule, should distribute GWG agenda prior to meeting
9/28/94	Wu, Felix	Interest in MIL-HDBK-17, add to distribution list
9/29/94	Pasternak, Bob	Thermal properties in CK0001 and CB0004 won't work, CHN to fax electronic input format for review,
9/30/94	Pasternak, Bob	Discussion of summary table revision, to go to Fields, Adelman, Hansen, Kruhmin, Soderquist, Hagnauer, electronic input OK, data prioritization - RP to approach after next week, WGC + suppliers
9/30/94	Kruhmin, Ted	Will be getting data documentation request, will not prevent inclusion in handbook, mix qualification and acceptance tests?, discussion re: normalization



**c. Significant Electronic Mail Contacts**

The following electronic mail was received or sent during this reporting period

MIL-HDBK-17 Project E-Mail (Sent) Log			
Date	Addressee(s)	File	Topic/Notes
9/07/94	Data pooling task group	DP19940907.EML	Comments/changes proposed to flowchart
9/ 8/94	Adelmann, John		Pooling fits using restricted definition
9/27/94	Working group chairmen		Schedule, general session minutes, agenda items

MIL-HDBK-17 Project E-Mail (Received) Log			
Date	Sender(s)	File	Topic/Notes
9/ 8/94	Adelmann, John		Comparable to avoid pooling
9/25/94	Carpenter, Joe		Cannot attend Forum
9/27/94	Poe, Buddy		email address
9/28/94	Garbo, Sam		Response to proceedings
9/28/94	Hagnauer, Gary		Email returned host unknown

**d. Significant Facsimile Contacts**

The following facsimile mail was received or sent during this reporting period:

MIL-HDBK-17 Project FAX's (Sent) Log		
Date	Addressee(s)	Topic/Notes
9/02/94	Ghilai, Gila	Response to STAT17 update info request
9/02/94	Kruhmin, Ted	Tentative agenda
9/02/94	Pasternak, Bob	Revised agenda
9/02/94	Roylance, Margaret	Tentative agenda

MIL-HDBK-17 Project FAX's (Sent) Log		
Date	Addressee(s)	Topic/Notes
9/06/94	Data Pooling task group	Mark Vangel's new information, Conference call confirmed
9/ 8/94	Hart, Bernie	Viewgraphs for publication schedule, meeting preparation, and progress
9/13/94	Kruhmin, Ted	List of lots for which we cannot access files
9/14/94	Campbell, Chris	Forum agenda
9/15/94	Hansen, Gary	Forum agenda
9/16/94	Bode, John	Memo to working group chairmen of 8/24/94
9/27/94	Working group chairmen	Schedule, general session minutes, agenda items

MIL-HDBK-17 Project FAX's (Received) Log		
Date	Sender(s)	Topic/Notes
9/06/94	Reeve, Scott	Engineering input to Data Pooling
9/06/94	Vangel, Mark	Analyses of prepreg/towpreg and fiber areal weight pooling cases
9/07/94	Adelmann, John	Data pooling flowchart
9/13/94	Kruhmin, Ted	Summary of lot identification and first two pages of spreadsheet files
9/14/94	Reeve, Scott	Data Pooling viewgraphs

#### 11. ENGINEERING CHANGE PROPOSAL STATUS

No engineering change proposals are outstanding at this time.

#### 12. CONTRACT SCHEDULE STATUS

There was no change to the contract schedule during this reporting period.

### **13. ACTIVITIES PLAN**

The following activities are planned for the next reporting period:

- a. Data analysis
- b. Distribution of letters to data sources noting status and requesting additional documentation
- c. Preparation of proceedings
- d. Addressing data pooling concerns

### **14. PREPARER**

This report was prepared by Crystal H. Newton, Project Engineer

Telephone: (215) 542-8400  
Facsimile: (215) 542-8401  
Electronic mail: crystal@bwr.com

### **15. APPENDICES**

A. Draft minutes of the MIL-HDBK-17 General Session



## **APPENDIX A**

**MIL-HDBK-17 COORDINATION GROUP MEETING**  
**22 September 1994**  
**MINUTES**

1. Gary Hagnauer opened the general session for MIL-HDBK-17 and welcomed the participants. Joe Soderquist noted the good work resulting from the MIL-HDBK-17 activities. Touchstone has volunteered an electronic bulletin board for use of the Coordination Group. The address for the bulletin board is <>. Instructions for its use are presented in Section <>.
2. Crystal Newton presented progress on the handbook summarizing the information in Section <>. The schedule for publication of the handbook, established during the Executive Session on Monday, is:

Change Notice 1, Volumes 1 and 3 including all material approved since January 1993	
End of review period New Orleans proceedings	15 Jan 1995
Release	15 Aug 1995

Revision D, Volume 2	
End of review period Reno proceedings	July 1995
Release	Feb 1996

Revision E, all three volumes	
Revision to outline completed, Spring Meeting	Mar 1996
Release	Oct 1996

Peter Shyprykevich asked what happens when negative comments are received on a section included in the yellow pages. If the comment is technical and cannot be resolved readily, it is referred back to the working group.

**Working group reports:**

3. Margaret Roylance presented the report of the Materials and Processes working group. Agenda item 91-09 on Weave Notation is being tabled pending an adequate description. Agenda item 89-08 on Quality Control is being returned to the Guidelines working group. The revision of Volume 3, Chapter 2 is being planned. As part of this activity, the overall scope and title for Volume 3 is being addressed. Chapter 2 should mention that the levels of materials and Processing information including traceability that is required depends on how critical a component or structure is.
4. The Testing working group report was presented by John Adelman. The section on matrix mechanical properties is being drafted. The matrix shear testing section was approved by the working group. Information applicable to Chapters 3 through 6 will be included in Chapter 6 with cross-references and modifying information in the other chapters. Gary Hansen presented a summary of the SACMA round robin. The section on fracture toughness was approved as were sections in Volume 1 referring to the multiaxial testing information in Volume 3. The working group is recommending that the revised numbering system in Chapter 6 be used for the Change Notice to Volume 1 Revision D. A section on compression after impact was approved with its location to be defined. Sam Garbo noted that an awareness statement is being added to Volume 3, Section 4.11 to note the relationship between dent depth and relaxation presented by Michelle Thomas.

The glass transition temperature section has been approved by the working group. The agenda item on recommendations on strain gages vs. extensometers is being closed and

rolled into a new agenda item on instrumentation. A new agenda item is being started on void volume methods to include photomicrographic methodology. The reporting and use of lamina shear stresses and strengths is being coordinated with ASTM Committee D-30.

5. The Braiding/Filament Winding report was presented by Don Jaklitsch. Revisions of sections 2.5 and 6.7 have been approved. A new agenda item is being started for filament winding terminology. A new name and an expanded scope are under consideration for the newly combined working group.
6. Bob Pasternak presented the Data Review working group report. Several data sets were approved including quasi-isotropic laminate and open hole tension. Conditional approval was noted in some cases. Coordination Group members and, in particular, Data Review working group members are reminded to check such data sets carefully when they appear in the yellow pages. The activities of the Data Pooling task group were reported. The normalization methods for the handbook are being revised with comments due to John Adelman. The draft on presentation of thermal properties is making progress. A change in the summary table presentation has been approved by the working group and will be included in the yellow pages for the spring meeting. Rather than present mean values and level of approval for a limited set of properties and conditions, the level of approval will be presented for all conditions.

The prioritization of data for the handbook will be addressed by a group of representatives from the working groups. The Materials and Processes working group would like to review the prioritization list each meeting with the working group chairmen identified as the contacts. The Braiding/Filament Winding Group plans to follow the same procedure. Other working groups will notify Bob Pasternak or Crystal Newton of their choice.

7. The Guidelines working group report was presented by Sam Garbo. Ten sections received working group approval at this meeting. The academic review was presented by Professor Hahn. Emphasis during this meeting was on reorganization and review. The working group is addressing broadening guidelines on the generic level, expanding into new areas, and recognizing cost as a major driver. There is a legitimate initiative to expand the applications scope of the handbook with increased input from our European colleagues. The drive to pull in data from forefront materials provides an opportunity to put aside the criticism of the handbook that it is not useful. In addition, the work toward addressing high temperature materials by Doug Ward was noted as was the efforts of Mark Vangel and the Statistics working group to respond to engineering needs. Scott Reeve has conducted a survey on receiving inspection that will form the basis of handbook sections. Joe Soderquist mentioned the Technical Service Order authorization initiative where the FAA will verify material characteristics at a level between the material supplier and contractor.
8. Mark Vangel presented the Statistics working group report. The Statistics working group has been involved with the Guidelines working group, in batch acceptance testing - selection of criteria, acceptance testing, establishing the number of specimens, and retesting. Data pooling and regression are also topics under consideration.
9. The Structural Joints working group report was presented by Peter Shyprykevich. Approximately 70% of the section on design and analysis of bonded joints has been approved; the remainder has been drafted. The draft of the rules of thumb for bolted joints is largely completed and the design and analysis of bolted joints is approximately half done. The working group is interacting with the Materials and Processes working group on bond surface preparation. Bob Gurrola presented a fastener manufacturer's perspective including working with lower bearing stresses in composites and providing a statistical basis for joint

allowables. Louis Anquez presented results from Dassault using a supported single shear specimen.

The Structural Joints working group decided not to move the test matrices in Chapter 7 to Chapter 2 with the rest of the test matrices. All test matrices on joints must be coordinated.

10. Jerome Connolly presented the Supportability working group report. The outline for Volume 3, Chapter 8 has been revised. A connection has been made with the International Air Transport Association Committee on Repair. Three presentations were made to the working group including Andrew Pearson's Transport Canada Perspective on Repair.
11. The Thick Section Composites report was presented by John Bode. The revision to Volume 3, Chapter 7 has been approved by the working group. The revision to the Introduction was also approved. The Physical Properties section is currently being drafted.
12. The agenda items list was reviewed by Crystal Newton. Changes to the list, as shown in Section <>, were approved by the Coordination Group.
13. The Spring Meeting will be at the Flamingo Hilton in Reno, Nevada. Monday is tentatively scheduled as a full day for the executive session which may include presentations regarding future directions for the handbook. Tuesday and Wednesday will be working group sessions followed by the General Session and Intersociety Forum on Thursday.

The next meeting of the metal matrix composites handbook will be the week of February 7 in conjunction with the Salt Lake City meeting. The separate meeting for the metal matrix area was discussed.

14. Joe Soderquist led the selection of the meeting site for Fall 1995. The first choice was Newport, Rhode Island with Clearwater, Florida, the second choice.
15. The meeting was adjourned at 11:30.